

**REVISED DRAFT REPORT ON ANALYSIS OF COST ESTIMATES  
FOR CLOSURE AND POST-CLOSURE CARE**

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## 1.0 INTRODUCTION

PRC Environmental Management, Inc. (PRC) received Work Assignment (WA) No. R11007 from the U.S. Environmental Protection Agency (EPA), under Contract No. 68-W4-0007, RCRA Enforcement, Permitting, and Assistance (REPA) Contract - Zone II. Under this WA, PRC was assigned a task to provide to EPA Headquarters support for determining the accuracy of cost estimates for closure and post-closure care that were prepared by owners and operators of hazardous waste treatment, storage, and disposal facilities (TSDF) under the Resource Conservation and Recovery Act (RCRA). PRC also was assigned a task under this WA to conduct analyses to determine whether correlations could be established between the timing and severity of enforcement actions undertaken at a facility and the closure of that facility. The information presented in this report will assist EPA in analyzing the effects of proposed changes in the requirements governing demonstration of financial responsibility for TSDFs.

Under an earlier WA, PRC evaluated cost estimates for closure and post-closure care for 100 TSDFs located throughout EPA Region 4. The facilities, selected by each of the eight states in the region, were chosen for review for various reasons (for example, compliance issues, pending enforcement actions, and pending closure).<sup>1</sup> PRC developed a summary report for each facility, comparing the estimates of the costs of closure and post-closure care that were prepared by owners or operators with those derived through the use of a model that PRC had developed for EPA. Under this WA, PRC compiled and analyzed the information in those reports in a manner consistent with the scope of work for this WA. This report presents the findings of those analyses and discusses the frequency with which the cost estimates prepared by owners and operators differed from those prepared through use of the standard model. The report also discusses the reasons for the differences between the estimates and identifies any trends or characteristics common to those facilities that have submitted estimates. Finally, the report discusses the relationship between enforcement activities and closure of a facility.

Section 2.0 presents the assumptions made by PRC in conducting analyses under this WA. Section 3.0 presents a comparative analysis of cost estimates for closure and post-closure care prepared by owners

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<sup>1</sup> Of the 100 TSDFs reviewed for this analysis, 16 were located in Alabama, 15 in Florida, 8 in Georgia, 9 in Kentucky, 7 in Mississippi, 10 in North Carolina, 15 in South Carolina, and 20 in Tennessee.

and operators of TSDFs and cost estimates prepared under a standard model. Section 4.0 presents an analysis of the effects of enforcement activities on closure of a facility. Section 5.0 presents general conclusions. The appendix presents actual cost estimate data for the 100 TSDFs that PRC evaluated under a previous WA.

## **1.1 BACKGROUND**

Subtitle C of RCRA establishes requirements that owners and operators provide financial assurance for TSDFs. The regulations require that owners and operators of facilities that seek to obtain a permit to manage hazardous waste prepare an estimate of the costs required to conduct proper closure and post-closure care activities at the subject facilities. In the past, EPA has experienced difficulties in ensuring the adequacy of cost estimates for closure and post-closure care that are used to establish the amount of financial assurance that owners and operators are required under RCRA to demonstrate. Recognizing this problem, EPA undertook an effort to develop a user-friendly standard model that could be used to review cost estimates for closure and post-closure care. In particular, EPA Region 4 initiated a WA to obtain the assistance of PRC in developing a standard model and using that model to evaluate the adequacy of cost estimates for closure and post-closure care submitted by owners and operators of TSDFs in Region 4.

Under that WA, PRC created a guidance manual titled *Evaluating Cost Estimates for Closure and Post-Closure Care of RCRA Hazardous Waste Management Units* (hereafter referred to as the methodology) to assist personnel of EPA and state agencies in reviewing cost estimates for closure and post-closure care submitted under RCRA. PRC developed the methodology to identify inadequacies in cost estimates for closure and post-closure care that owners or operators prepare at the time of permitting. The methodology provides to EPA and state permit writers a method of evaluating estimates of the costs of closure and post-closure care and allows them to verify that costs for all necessary activities are included and that the costs estimated for those activities are reasonable.

The methodology includes: (1) a discussion of the general closure activities conducted by the owner or operator for each type of hazardous waste management unit and a flow chart illustrating those activities, (2) information about factors that can affect the accuracy of cost estimates for the unit, and (3) cost estimating worksheets for the unit. The worksheets are the primary tools provided in the manual to

evaluate the accuracy of cost estimates prepared by owners and operators of TSDFs for closure and post-closure care activities. The worksheets are designed to be used with data obtained from approved plans for closure and post-closure care. The worksheets, which follow the flow of work as it would be conducted when closing the unit, include costs for specific activities or equations for calculating line-by-line costs for specific items.

After developing the methodology, PRC used it to evaluate cost estimates for closure and post-closure care that had been submitted by owners or operators of 100 TSDFs in EPA Region 4. Using information provided in each facility's closure plan and RCRA Part B permit application, PRC developed independent estimates of the costs of closure and post-closure care for each of the 100 facilities evaluated in this study. PRC developed those estimates over a three-year period, from 1993 to 1995. PRC then prepared a summary report that discusses each facility, the cost estimates for closure and post-closure care submitted by the owner or operator, the estimate developed by PRC under the methodology, and a comparison of the two estimates. The report identifies specific activities for which the owner or operator may have underestimated costs for closure and post-closure care.

The reviews conducted by PRC in 1993 were intended not only to evaluate the adequacy of the cost estimates for closure and post-closure care submitted by owners and operators, but also to evaluate and refine the methodology. At the request of the EPA work assignment manager (WAM), PRC prepared cost estimates for each facility, using costs for all appropriate closure activities identified in the methodology, regardless of the costs provided by the facility, to develop a truly independent estimate. In 1994 and 1995, at the request of the EPA WAM, PRC conducted its review in a slightly different manner. PRC developed the estimates using the methodology while including the costs of closure activities provided in the cost estimate prepared by the owner or operator, provided that those costs were within an acceptable range, as identified in the methodology.

## **2.0 ASSUMPTIONS**

Assumptions were made to compile data for the analyses presented in this report. Those assumptions are summarized below.

In evaluating the adequacy of cost estimates for closure and post-closure care for 100 TSDFs, PRC noted

that some owners or operators had prepared more detailed estimates than others. To develop an independent cost estimate, PRC made numerous assumptions when information was not provided in the owner's or operator's cost estimate. Some of the assumptions commonly made included: (1) the specific level of personal protection to be used during decontamination and closure activities, (2) the specific decontamination methods, (3) the specific treatment and disposal methods, (4) the specific methods of sampling analysis and number of samples to be collected, and (5) the dimensions of the units.

PRC prepared cost estimates for all activities deemed necessary to accomplish closure or post-closure care in accordance with requirements under RCRA. Some of those activities may not have been addressed by the owner or operator. The breakdown of activity costs provided by the owner or operator sometimes differed from the breakdown of activity costs identified under the methodology. PRC attempted to structure the activity costs identified by the owner or operator in a manner that allowed a one-to-one comparison with costs prepared under the methodology. Comparison of costs prepared by owners and operators with costs derived under the methodology for each unit was possible only when the owner or operator presented cost information at the unit level.

The reviews performed by PRC were based on the most recent data available from the states. When key information was not available, PRC attempted to contact the appropriate state agency to obtain more information. When PRC conducted its review, cost estimates for some facilities were several years old (prepared in 1988 or 1989, for example). Those cost estimates were adjusted for inflation through either 1993, 1994, or 1995, depending on the year in which PRC performed the review. Costs were adjusted by applying inflation factors derived from the Implicit Price Deflators for Gross National Product published by the U.S. Department of Commerce, as specified in 40 Code of Federal Regulations (CFR) 264.142(b).

The 100 cost estimates analyzed in this report may not be representative of all TSDFs in EPA Region 4 or of TSDFs located in other EPA regions. The facilities were selected for review by the states, for various reasons, including compliance issues, pending enforcement actions, and pending closure. The geographic limitations of the data set and the manner in which the facilities were selected by the states should be considered when reviewing the analyses and findings presented in this report.

### **3.0 COMPARISON OF ESTIMATES OF COSTS OF CLOSURE AND POST-CLOSURE CARE**

This report presents the frequency with which the cost estimates prepared by owners and operators differ from those prepared under the methodology, discusses the likely reasons for such differences, and identifies any trends or characteristics common to the facilities for which cost estimates were reviewed. The following sections present findings derived by PRC through conduct of various analyses using the cost estimate data.

#### **3.1 DISTRIBUTION OF FACILITIES BY AVERAGE PERCENT DIFFERENCE**

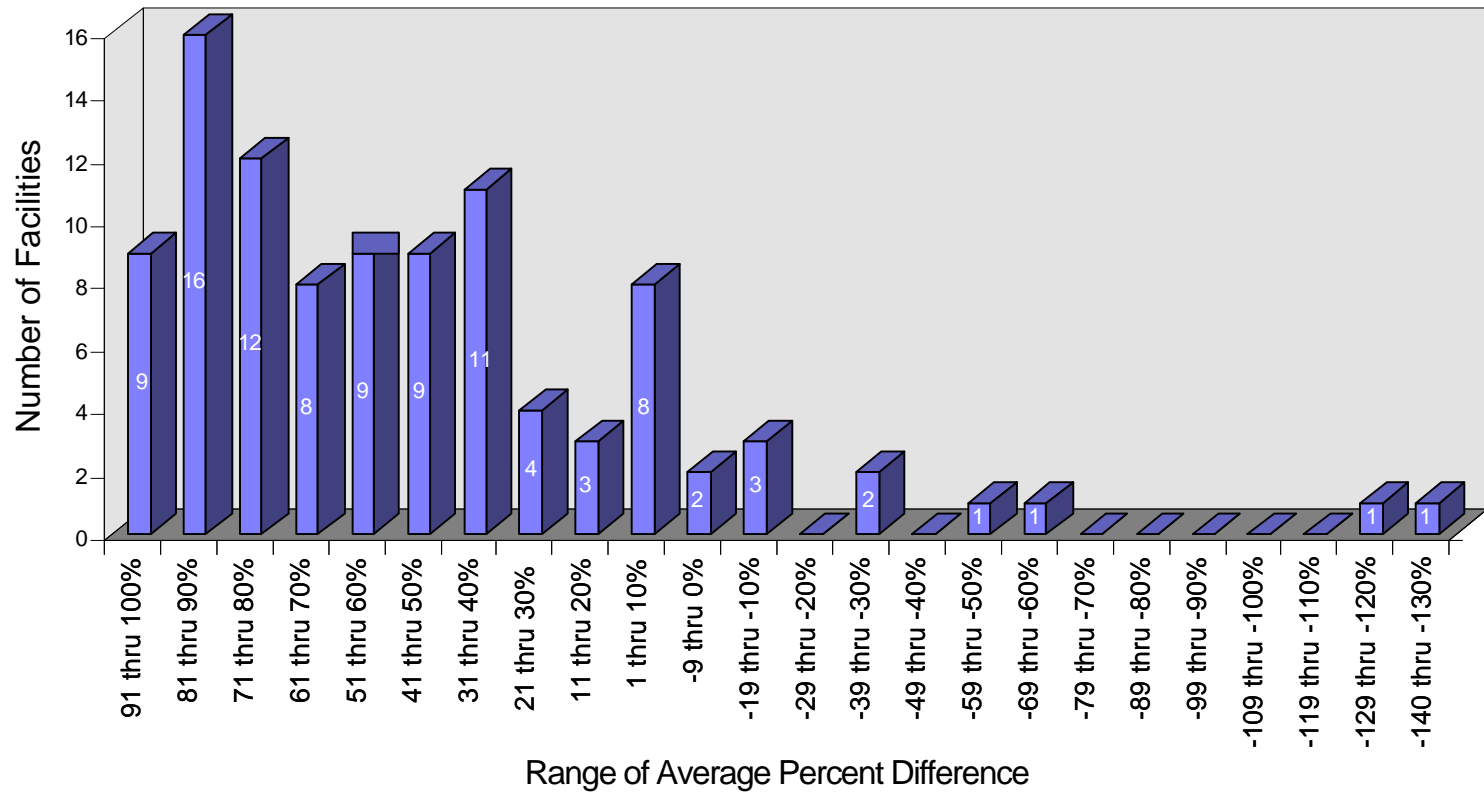
The analyses performed for this report focus on the average percent difference between the cost estimates submitted by owners and operators and the cost estimate prepared under the methodology. Figure 1 presents a distribution of facilities by the average percent difference between the two cost estimates, allotted into groups of 10 percentage points each.

PRC determined that the cost estimates prepared by owners and operators for 89 of the 100 facilities reviewed were lower than the corresponding cost estimates prepared under the methodology. Cost estimates for 54 of the facilities were more than 50 percent below the estimates prepared under the methodology. Within that group, cost estimates for nine facilities were from 91 percent to 100 percent lower, cost estimates for 16 facilities were from 81 percent to 90 percent lower, cost estimates for 12 facilities were from 71 percent to 80 percent lower, cost estimates for eight facilities were from 61 percent to 70 percent lower, and cost estimates for nine facilities were from 51 percent to 60 percent lower than the estimates prepared under the methodology. Out of the group of 89 facilities identified above, cost estimates for 35 facilities were 50 percent or less than 50 percent lower than the estimates prepared under the methodology. Within that group, cost estimates for nine facilities were from 41 percent to 50 percent lower, cost estimates for 11 facilities were from 31 percent to 40 percent lower, cost estimates for four facilities were from 21 percent to 30 percent lower, cost estimates for three facilities were from 11 percent to 20 percent lower, and cost estimates for eight facilities were from 1 percent to 10 percent lower than the estimates prepared under the methodology.

PRC also determined that cost estimates prepared by owners and operators for 11 facilities were greater than or equal to the corresponding cost estimates prepared for those facilities under the methodology.



**Figure 1**  
**Distribution of Facilities by Average Percent Difference**



Within that group, cost estimates prepared by owners and operators for two facilities were from 0 percent to 9 percent greater, cost estimates for three facilities were from 10 percent to 19 percent greater, cost estimates for two facilities were from 30 percent to 39 percent greater, the cost estimate for one facility was 50 percent to 59 percent greater, the cost estimate for one facility was from 60 percent to 69 percent greater, the cost estimate for one facility was from 120 percent to 129 percent greater, and the cost estimate for one facility was from 130 percent to 140 percent greater than the estimates prepared under the methodology.

Table 1 presents cost estimate data for the 100 facilities broken out by median, range, and average percent difference. As the table shows, the median value of the cost estimates prepared by owners and operators is 54.92 percent lower than the median value of the cost estimates prepared under the methodology. Cost estimates prepared by owners and operators range from 99.33 percent below to 140.37 percent above the corresponding cost estimates prepared under the methodology. Finally, cost estimates prepared by owners and operators differ, on average, by 46.53 percent from the cost estimates prepared under the methodology for the same facilities.

The total of estimated costs prepared by owners and operators for the 100 TSDFs was \$142,560,794. The total of estimated costs prepared under the methodology for the 100 facilities was \$599,484,160.

**Table 1**  
**Median, Range, and Average Percent Difference of Cost Estimate Data**

<b>Analytical Method</b>	<b>Cost Estimates Prepared by Owners and Operators (\$)</b>	<b>Cost Estimates Prepared Under the Methodology (\$)</b>	<b>Average Percent Difference (%)<sup>2</sup></b>
Median	503,025	1,498,653	54.92
Range	11,697 - 32,949,040	11,762 - 293,356,710	(140.37) - 99.33
Average	1,425,608	5,994,842	46.53

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<sup>2</sup> Values shown in parenthesis are negative.

### **3.2 ANALYSIS OF AVERAGE PERCENT DIFFERENCE BY SIZE OF FACILITY**

To analyze the percent difference in costs estimates by facility size, PRC categorized the facilities as small, medium, or large, according to the number of units at the facility. For this report, facilities that had one or two units were categorized as small. Facilities that had three to six units were categorized as medium, and those that had seven or more units were categorized as large. The numbers of small, medium, and large facilities are 43, 28, and 29, respectively. The facilities ranged in size from 1 unit to 155 units. Of the 100 facilities evaluated, only one had more than 61 units.

Figure 2 presents the average percent difference between the cost estimates prepared by the owners and operators of the TSDFs and the cost estimates prepared under the methodology for each of the three categories of facilities. The average percent difference for small, medium, and large facilities is 29.70 percent, 49.07 percent, and 67.69 percent, respectively. The analysis indicates that the difference between cost estimates tends to increase with the size of the facility. Because of economies of scale (the assumption that the cost of closure per unit decreases when several units are closed at the same time) and a tendency to incorporate shared costs for common activities, costs may be underestimated more frequently and to a greater extent by the owners and operators of large facilities than by the owners and operators of small and medium facilities. Because the methodology is designed to estimate the costs of closure and post-closure care on a per-unit basis, the approach taken by owners and operators may result in the calculation of cost estimates that are significantly below the estimates prepared under the methodology.

### **3.3 ANALYSIS OF AVERAGE PERCENT DIFFERENCE BY FINANCIAL ASSURANCE MECHANISM**

This analysis is focused on the average percent difference between the cost estimates prepared by the owners and operators of the facilities and the cost estimates prepared under the methodology, sorted by financial assurance mechanism. For this analysis, facilities were categorized by the type of mechanism that that facility currently uses to demonstrate financial assurance for closure and post-closure care.

**Figure 2**  
**Average Percent Difference by Size of Facility**

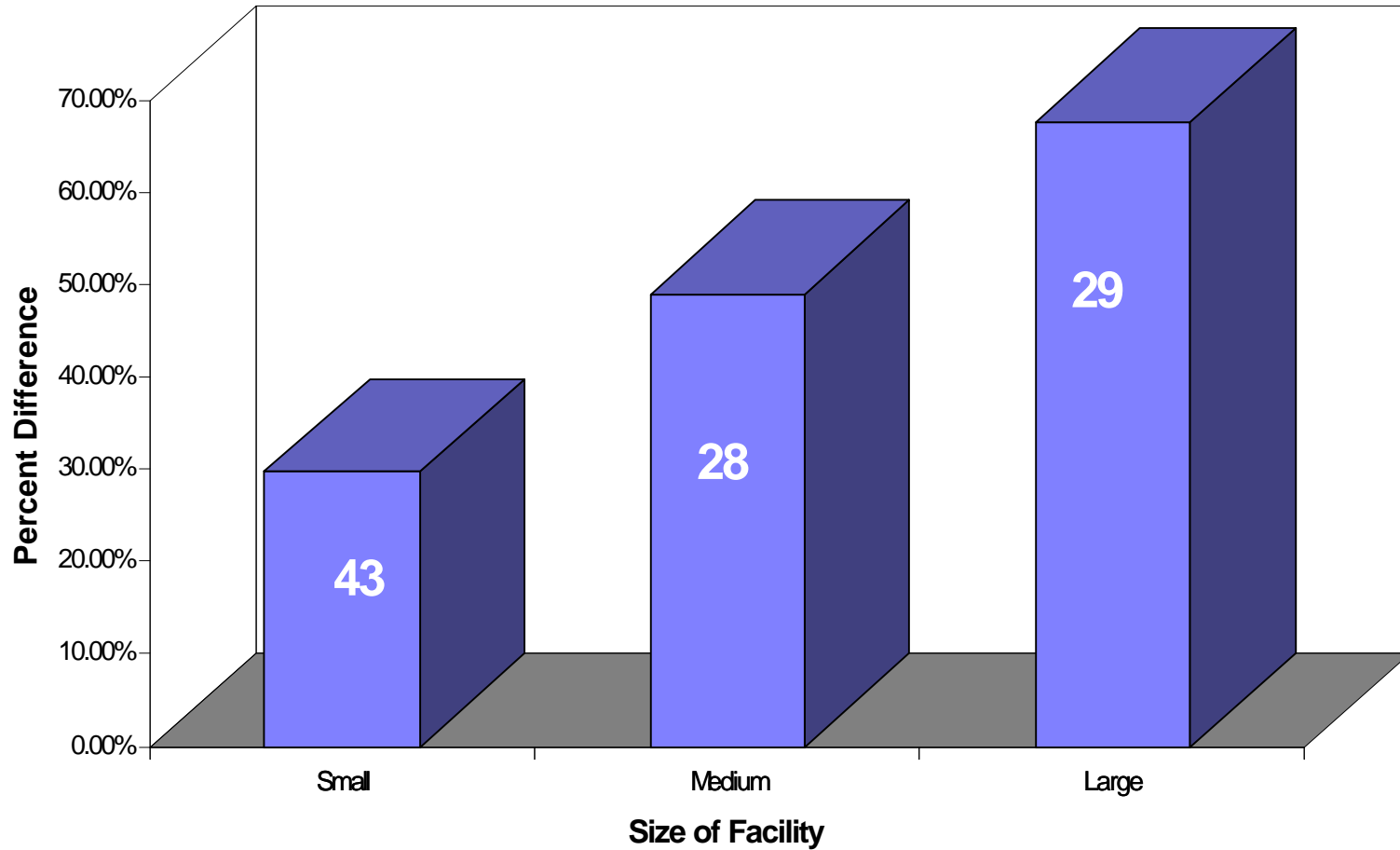


Table 2 shows the number of TSDFs using each type of financial assurance mechanism.

**Table 2**  
**Number of Facilities by Financial Assurance Mechanism**

Financial Mechanism	Number of Facilities
Corporate Guarantee	10
State mechanisms	3
Financial test	35
Insurance	5
Letters of Credit	30
None	1
Surety bonds	4
Trust funds	12

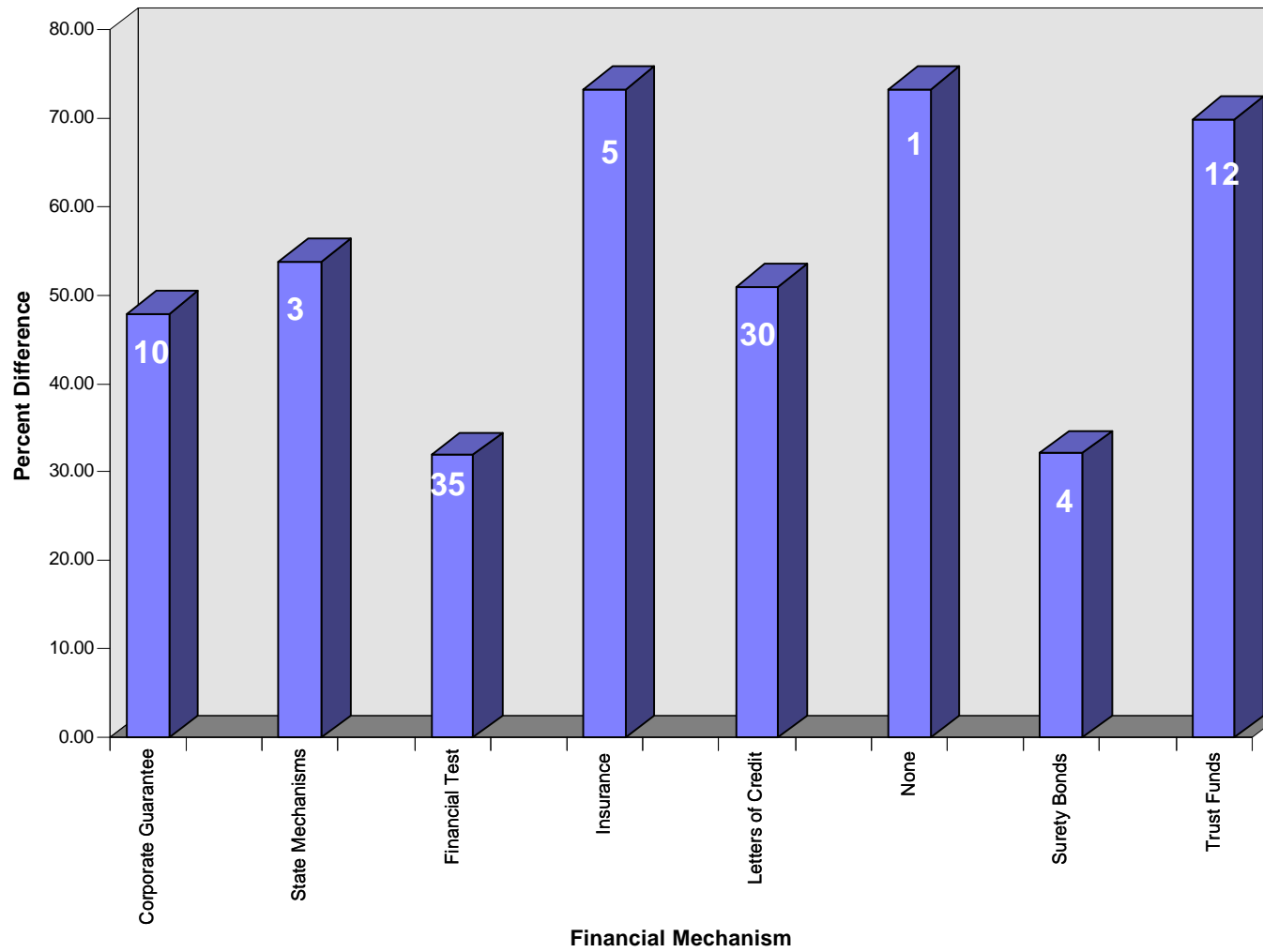
Figure 3 displays the average percent difference between cost estimates for facilities, by financial assurance mechanism. Data presented in the figure indicate that owners or operators that elect to use surety bonds, the financial test, and the corporate guarantee to demonstrate financial assurance for closure and post-closure care appear to prepare cost estimates that are more conservative, on average, than those prepared by owners and operators who use other types of mechanisms or who use no mechanism at all. In the case of surety bonds, it is possible that strict oversight imposed by surety companies or inquiries made during the typically stringent underwriting process might have encouraged owners and operators to prepare more conservative cost estimates.

The data also indicate, however, that owners and operators that elected to use letters of credit, state mechanisms,<sup>3</sup> trust funds, and insurance to demonstrate financial assurance for closure and post-closure

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<sup>3</sup> State mechanisms include escrow accounts and certificates of deposit.

**Figure 3**  
**Average Percent Difference by Financial Mechanism**



care, or that currently use no mechanism to demonstrate such assurance,<sup>4</sup> appear to have prepared cost estimates that are less conservative, on average, than those prepared by owners and operators who use the other types of mechanisms described above. Letters of credit and trust funds are third-party mechanisms that tend to be used by smaller facilities and that may be subject to less scrutiny by a third party than are surety bonds.

The two mechanisms also require that owners and operators make cash outlays that are based on the value of the cost estimates. The use of such mechanisms, therefore, may entail a lack of incentive to provide accurate estimates of costs. Although owners and operators that elect to use insurance to demonstrate financial assurance for closure and post-closure care presumably would undergo a thorough underwriting procedure similar to that used for surety bonds, cost estimates prepared by such owners and operators appear to be the least conservative, on average, among owners and operators that used any type of financial mechanism to demonstrate financial assurance.

### **3.4 ANALYSIS OF AVERAGE PERCENT DIFFERENCE BY ACTIVITY**

This analysis is focused on the average percent difference between the cost estimates prepared by owners and operators for a particular type of closure or post-closure care activity and the corresponding cost estimates prepared for those same activities under the methodology. For this analysis, closure and post-closure care activities were categorized as:

- Administrative and engineering costs
- Certification of closure
- Certification of post-closure care
- Contingency costs
- Decontamination
- Disassembly
- Installation of cover
- Post-closure care

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<sup>4</sup> Because of a bankruptcy, one facility PRC reviewed for this study currently uses no mechanism to demonstrate financial assurance for closure and post-closure care.

- Removal of waste
- Sampling and analysis
- Transportation, treatment, and disposal

Figure 4 displays the average percent difference and the total cost amounts for each type of activity. For each activity, two bars are shown. The bar to the left represents the average percent differences for all facilities for that activity. The bar to the right normalizes the data by calculating the percent difference for the activity only when the owner or operator provided a cost for that activity. If the owner or operator did not estimate the cost of a particular activity, the percent difference is 100 percent. When those cases are excluded, the average percent difference shown in the right bar for each activity indicates the accuracy of the cost estimate prepared by the owner or operator for that activity, compared with the cost derived under the methodology. It is of interest to note that costs for certification of closure and certification of post-closure care frequently were omitted from estimates prepared by owners and operators. When owners or operators did include such costs, however, the estimates prepared typically were higher than those prepared under the methodology.

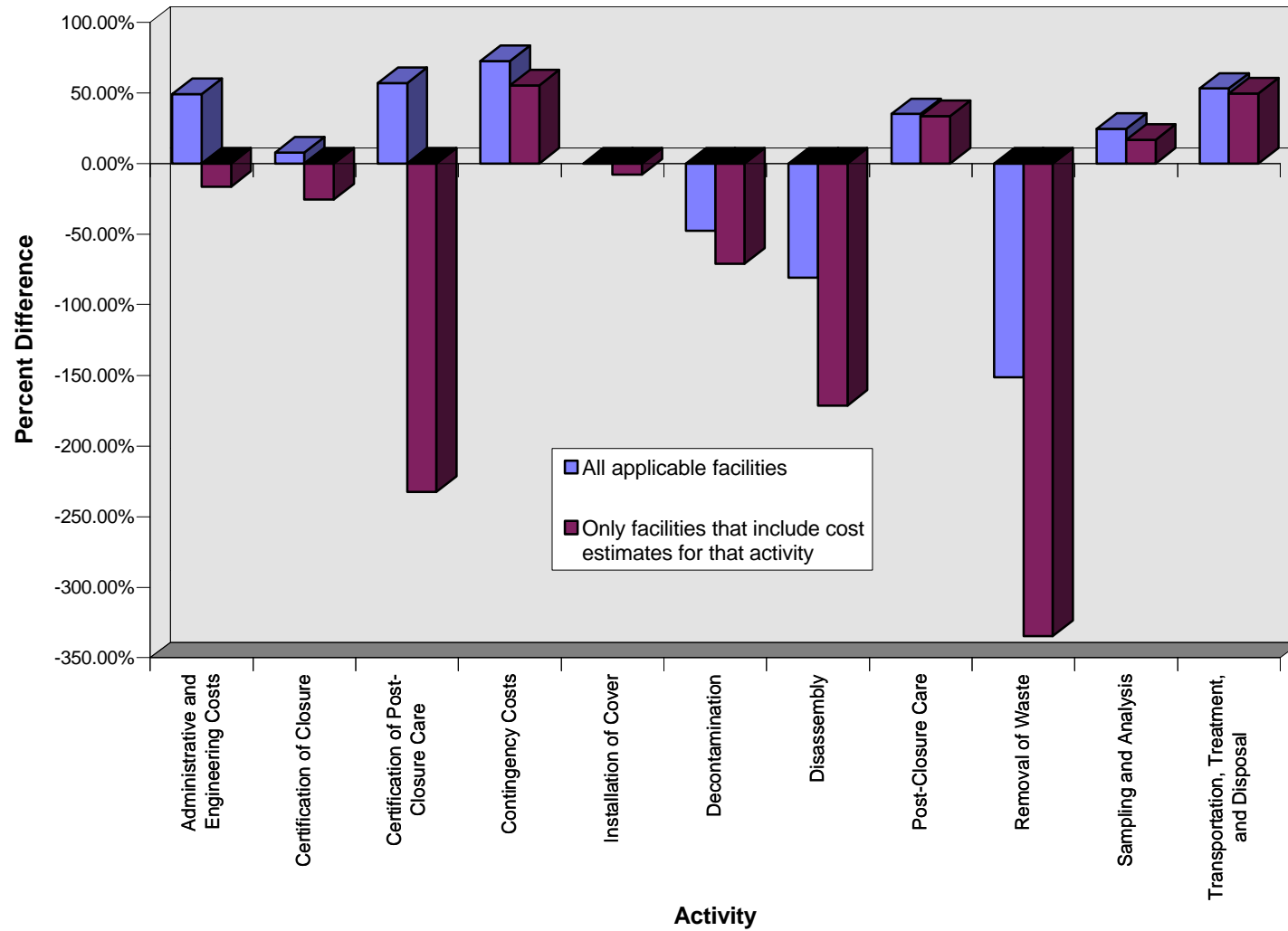
Information presented in Figure 4 indicates that cost estimates for 1) contingencies, 2) transportation, treatment and disposal, 3) post-closure care, and 4) sampling and analysis that were prepared by owners and operators were lower, on average, than costs prepared under the methodology by 55.33 percent, 49.55 percent, 33.52 percent, and 16.75 percent, respectively. PRC believes that cost estimates prepared by owners and operators for treatment, transportation, and disposal activities often may be low because owners and operators do not adhere closely to the criteria outlined in 40 CFR 264.142(a) when preparing such estimates.<sup>5</sup> In addition, costs of disposal at times may be low because owners and operators tend to fail to account for the costs associated with managing decontamination fluids as a hazardous waste. Estimates of contingency costs typically are based on a percentage of the total cost estimate for a facility and therefore also may be low, if the total cost estimate is low. Estimates of costs of post-closure care

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<sup>5</sup> 40 CFR 264.142(a) specifies that: 1) the estimate must equal the cost of final closure at the point in the facility's active life when the extent and manner of its operations would make closure most expensive; 2) the estimate must be based on the costs to the owner or operator of hiring a third party to close the facility; 3) the estimate may not incorporate any salvage value that may be realized at the time of closure; and 4) the owner or operator may not incorporate a zero cost for the disposal of waste that might have economic value.



**Figure 4**  
**Average Percent Difference by Activity**



also frequently may be low because many owners and operators do not include in their estimates the costs of all tasks and equipment needed to complete the required activities.

The analysis also reveals that cost estimates prepared by owners and operators for 1) removal of waste, 2) certification of post-closure care, 3) disassembly, 4) decontamination, 5) certification of closure, 6) administration and engineering, and 7) installation of cover were higher, on average, than costs prepared under the methodology by 334.47 percent, 232.63 percent, 171.34 percent, 70.87 percent, 25.54 percent, 16.56 percent, and 7.85 percent, respectively.

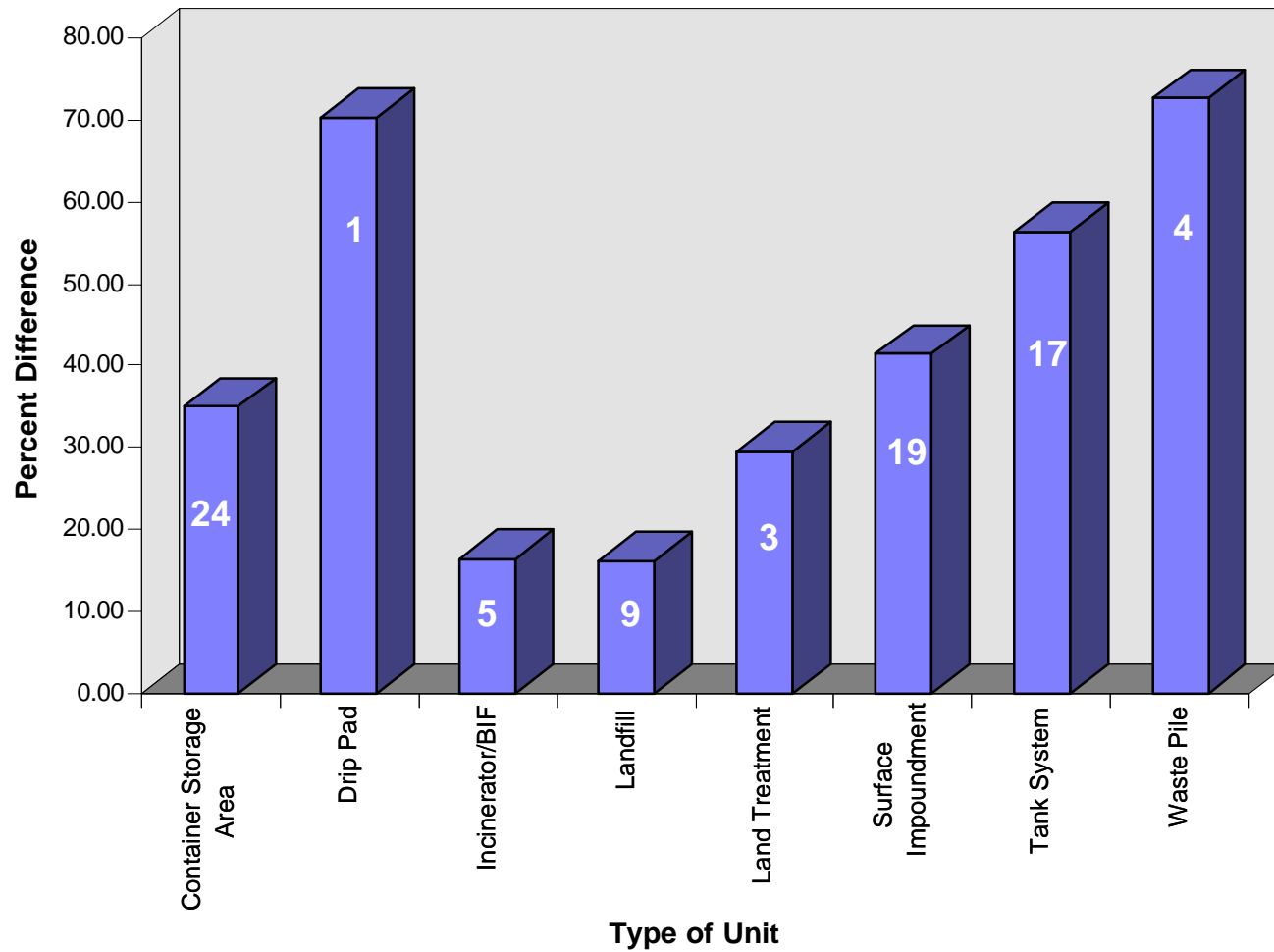
### **3.5 ANALYSIS OF AVERAGE PERCENT DIFFERENCE BY TYPE OF UNIT**

This analysis is focused on the percent difference between cost estimates prepared by owners or operators for particular types of units and cost estimates for those units prepared under the methodology. Of the 100 facilities analyzed, 59 provided unit-level cost data for all units and 3 provided unit-level cost data for some units. The remaining 41 facilities provided no unit-level cost data and, therefore, were omitted from this analysis. Figure 5 displays the average percent difference in cost estimates for each type of unit. Table 3 shows the number and types of units for which unit-specific cost data were available.

**Table 3**  
**Number and Type of Units for Which Unit-Specific Cost Data Were Available**

<b>Type of Unit</b>	<b>Number of Units</b>
Container storage areas	24
Drip pads	1
Incinerators and boilers and industrial furnaces (BIF)	5
Landfills	9
Land treatment units	3
Surface impoundments	19
Tank systems	17
Waste piles	4

**Figure 5**  
**Average Percent Difference by Type of Unit**



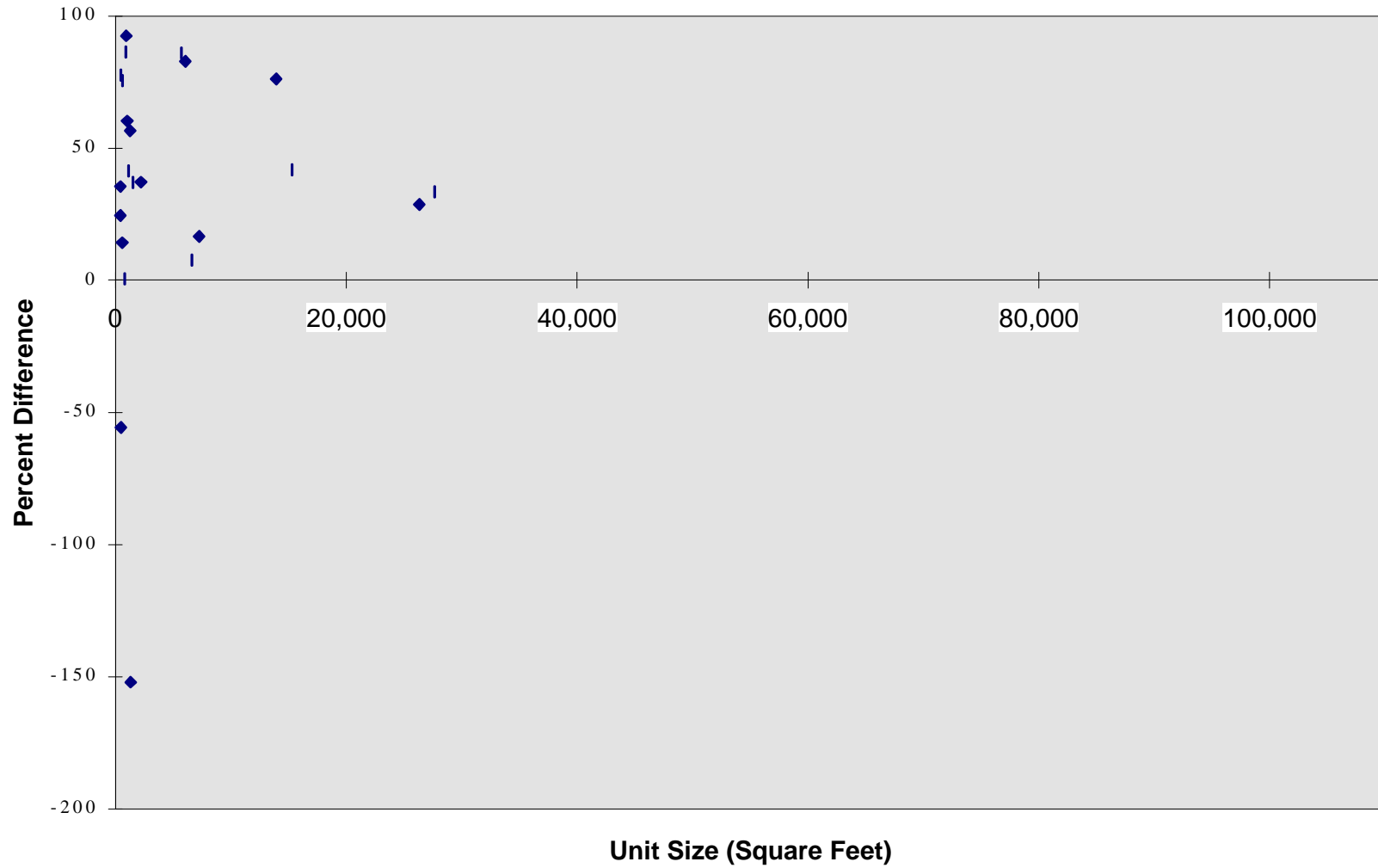
Because data points for drip pads and land treatment units are extremely limited, no findings could be derived for those two types of units. The information presented in Figure 5 indicates that the percent difference between cost estimates prepared by owners or operators and cost estimates prepared under the methodology tends to be greater in the case of waste piles and tank systems than in the case of other types of units. Cost estimates prepared by owners and operators for waste piles and tank systems were lower, on average, than cost estimates prepared under the methodology by 72.58 percent and 56.35 percent, respectively.

The analysis also reveals that cost estimates prepared by owners or operators for surface impoundments, container storage areas, land treatment units, incinerators and BIFs, and landfills, while still underestimated, conform more closely with the estimates derived under the methodology than for the estimates of the other types of units described above. Cost estimates prepared by owners or operators for surface impoundments, container storage areas, land treatment units, incinerators and BIFs, and landfills were lower, on average, than cost estimates prepared under the methodology by 41.40 percent, 34.98 percent, 29.55 percent, 16.37 percent, and 16.14 percent, respectively.

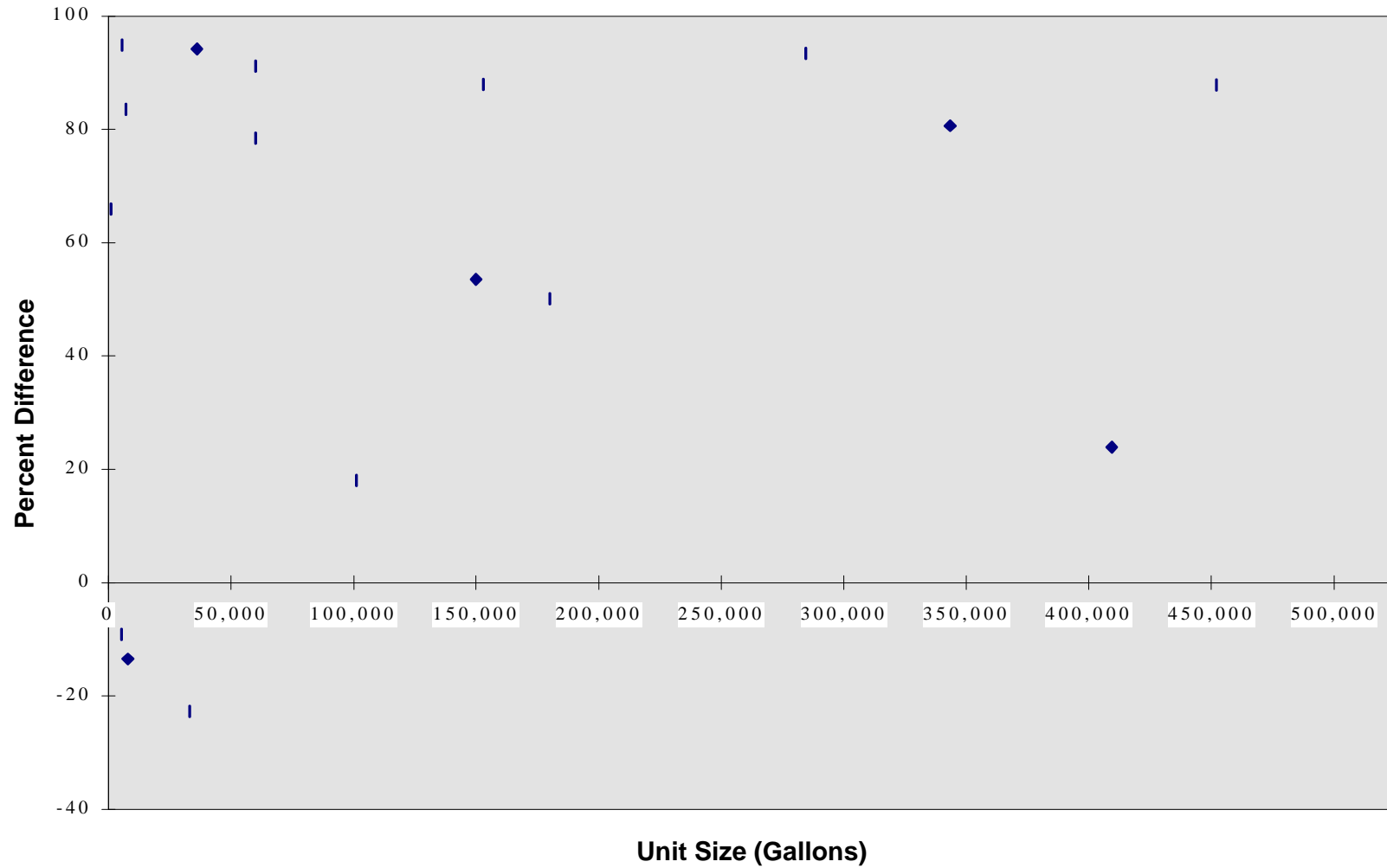
### **3.6 ANALYSIS OF AVERAGE PERCENT DIFFERENCE BY UNIT SIZE**

This analysis is focused on the percent difference between the two cost estimates, according to the size of a particular unit. For some types of units, only a small number of data points are available. This analysis, therefore, was limited to container storage areas (24 units), tank systems (17 units), and landfills (9 units). Surface impoundments could not be analyzed by unit size because some owners or operators based their estimates on area, while other owners or operators based their estimates on capacity. Figures 6, 7, and 8 display the percent difference for each unit and the size of that unit. For each figure, the x-axis represents the area or capacity of the unit. The y-axis on the left side represents the percent difference between the cost estimates prepared by owners or operators and the cost estimates prepared under the methodology. Information presented in the figures indicates that there is no apparent relationship between the size of a unit and the percent difference between the cost estimates.

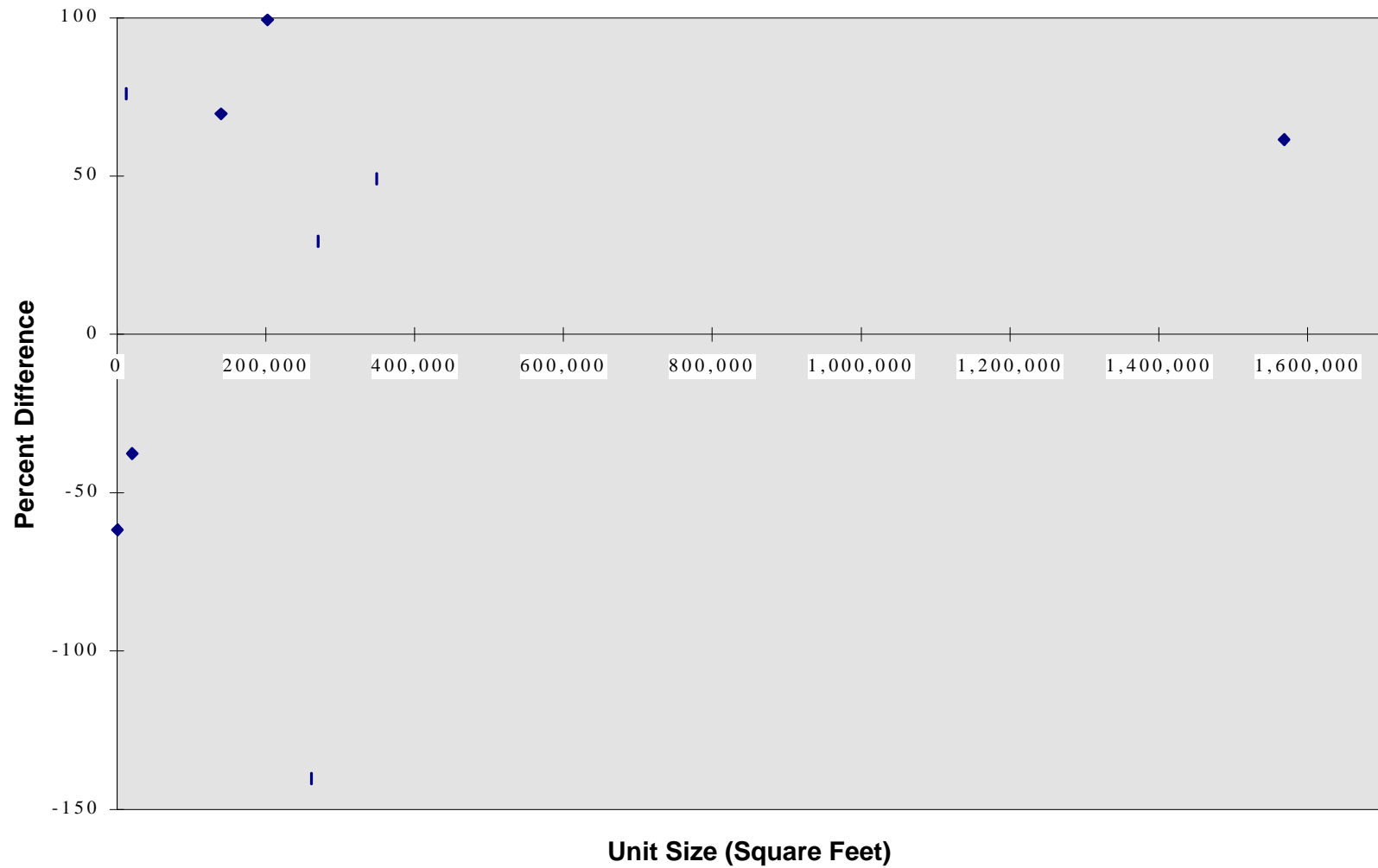
**Figure 6**  
**Container Storage Areas - Average Percent Difference by Unit Size**



**Figure 7**  
**Tank Systems - Average Percent Difference by Unit Size**



**Figure 8**  
**Landfills - Average Percent Difference by Unit Size**



### **3.7 ANALYSIS OF AVERAGE PERCENT DIFFERENCE BY DEGREE OF ENFORCEMENT ACTIVITY**

PRC conducted analyses to determine whether owners and operators of TSDFs that were subject to various degrees of enforcement activities had prepared cost estimates for closure and post-closure care for those facilities that were higher or lower than the cost estimates prepared under the methodology. To conduct this analysis, PRC organized the facilities listed above into four general categories: 1) facilities subject to no enforcement actions, 2) facilities subject only to informal enforcement actions, 3) facilities subject to formal enforcement actions that did not result in monetary penalties, and 4) facilities subject to formal enforcement actions that did result in monetary penalties. Among the facilities in each category, PRC compared the extent of enforcement activities that had occurred with the average percent difference between cost estimates prepared by owners or operators and cost estimates prepared under the methodology.

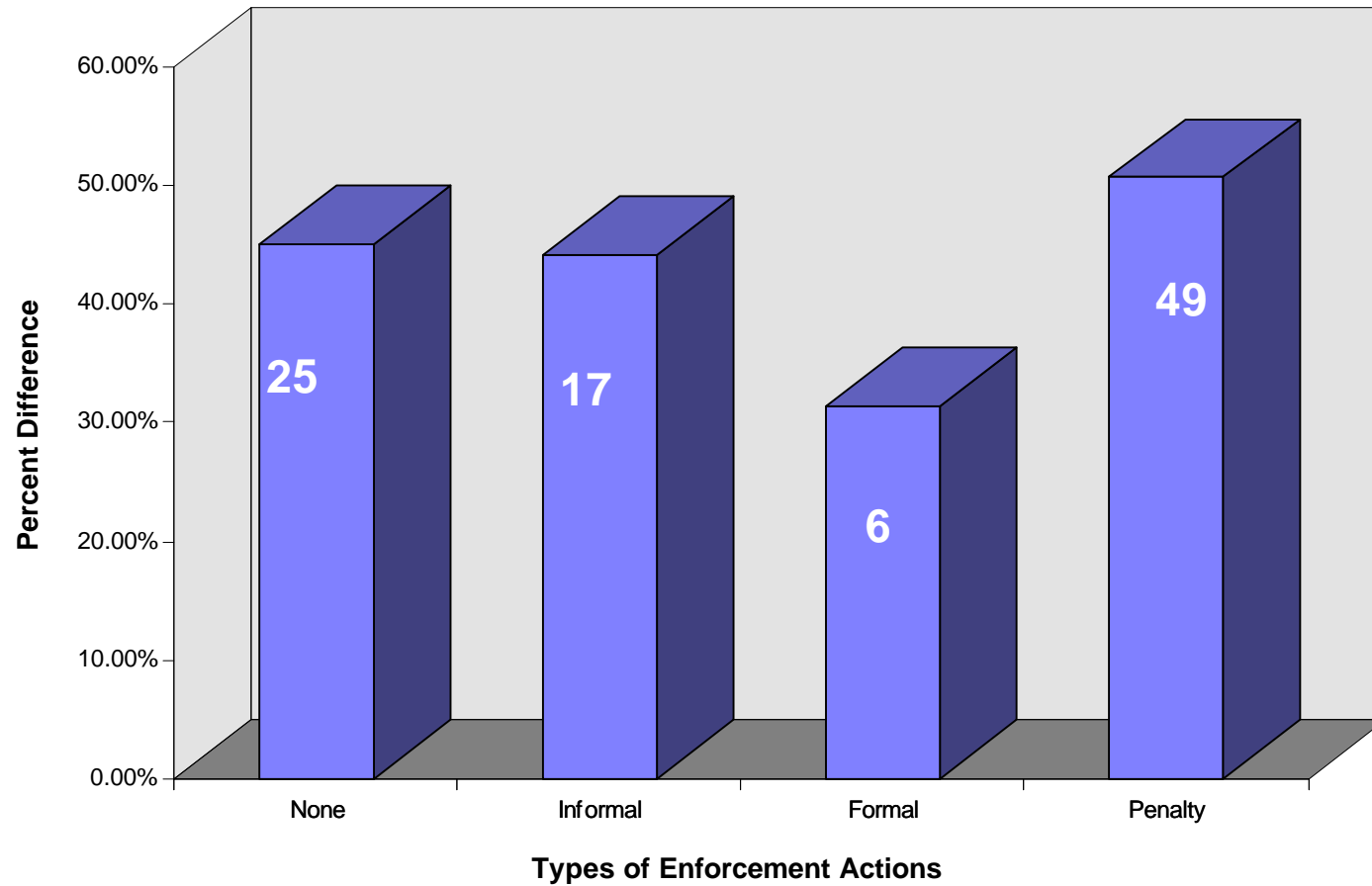
Figure 9 illustrates the percent difference in cost estimates for facilities in each category of enforcement activities. Cost estimates prepared by owners or operators of 1) facilities that were subject to formal enforcement actions that did result in monetary penalties, 2) facilities that were subject to no enforcement actions, 3) facilities that were subject only to informal enforcement actions, and 4) facilities that were subject to formal enforcement actions that did not result in monetary penalties were lower, on average, than cost estimates prepared under the methodology by 50.68 percent, 45.02 percent, 44.15 percent, 31.40 percent, respectively. The data indicate that owners and operators of facilities subject to enforcement actions that did not result in a monetary penalty appear to prepare cost estimates that are more conservative, on average, than those prepared by owners and operators of facilities that were subject to different types of enforcement activities. Conversely, owners and operators of facilities that were subject to enforcement actions that did result in monetary penalties appear to have prepared cost estimates that are less conservative, on average, than those prepared by owners and operators of other types of facilities.

### **4.0 EFFECTS OF ENFORCEMENT ACTIVITIES ON THE CLOSURE OF FACILITIES**

Originally under this WA, PRC was assigned a task to determine the frequency with which TSDFs have closed prematurely and, if possible, the reasons for early closure - for example, an enforcement action.



**Figure 9**  
**Average Percent Difference by Types of Enforcement**  
**Actions**



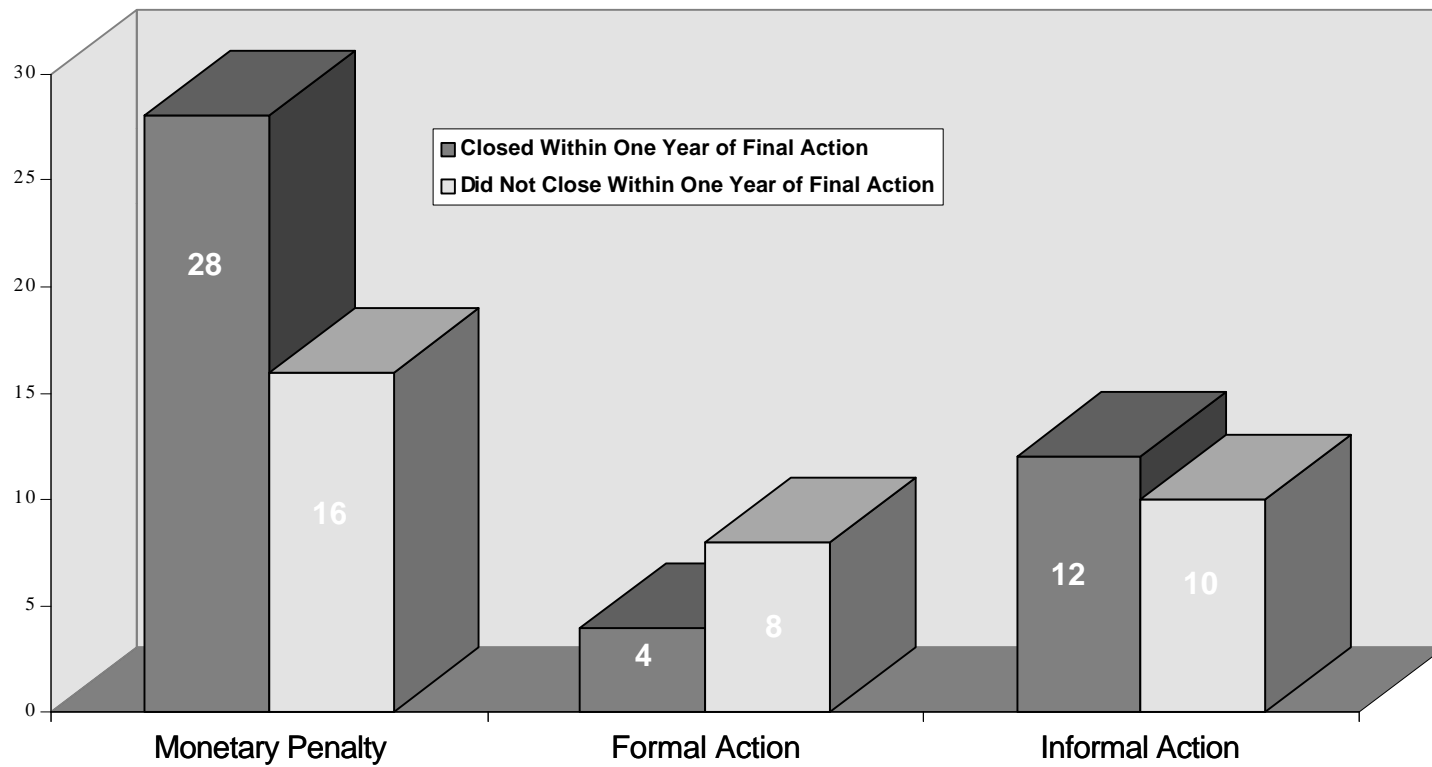
In attempting to complete that analysis, PRC conducted a search of the Resource Conservation and Recovery Information System (RCRIS) to 1) identify the date of closure of each facility in EPA Region 4 that was closed between 1989 and 1995 and 2) compare that date against the original intended date of closure for the facility to determine whether the facility was closed prematurely. Through use of RCRIS, PRC was able to identify dates of closure, as well as histories of enforcement activities, for all facilities in EPA Region 4 that were closed between 1989 and 1995. However, because data identifying the intended date of closure for those facilities were not available through RCRIS, PRC was unable to complete the analysis as planned.

Recognizing the limitations of the RCRIS data, the EPA WAM modified the scope of this task and directed PRC to conduct analyses to determine whether, in any cases, it could be demonstrated that varying degrees of enforcement activities resulted directly in the closure of facilities. To conduct this analysis, PRC organized the facilities identified above into four categories: 1) facilities at which no enforcement actions had been taken, 2) facilities at which only informal enforcement actions had been taken, 3) facilities at which formal enforcement actions that did not result in monetary penalties had been taken, and 4) facilities at which formal enforcement actions that did result in monetary penalties had been taken. For facilities in each category, PRC then reviewed the proximity of the dates of enforcement activities to the date of closure to determine whether chronological correlations could be established between the timing and severity of enforcement activities and closure of the facility.

Through its analysis, PRC determined that 209 TSDFs were operating in EPA Region 4 in 1990. PRC also determined that 85 of those TSDFs, or 40.7 percent, had closed by 1995. Of the 85 closed facilities, 7 had been subject to no enforcement actions, 22 had been subject only to informal enforcement actions, 12 had been subject to formal enforcement actions that did not result in monetary penalties, and 44 had been subject to formal enforcement actions that did result in monetary penalties.

Figure 10 presents the number of facilities within each enforcement category that closed within one year after the date of the final enforcement action at the facility and the number of facilities that did not close within one year after the date of the final enforcement action at the facility. The seven facilities at which no enforcement actions had been taken were not included in this analysis.

**Figure 10**  
**Proximity of Enforcement Actions to Date of Closure**



PRC determined that, of the 22 facilities that were subject only to informal enforcement actions, 12 facilities, or 54.5 percent, closed within one year after the date of the final enforcement action while 10 facilities, or 45.5 percent, did not close within one year. PRC also determined that of the 12 facilities that were subject to formal enforcement actions that did not result in monetary penalties, 4 facilities, or 33.3 percent, closed within one year after the date of the final enforcement action while 8 facilities, or 66.7 percent, did not close within one year. Finally, PRC determined that of the 44 facilities that were subject to formal enforcement actions that did result in monetary penalties, 28 facilities, or 63.6 percent, closed within one year after the date of the final enforcement action while 16 facilities, or 36.4 percent, did not close within one year.

The data indicate that facilities that are subject to enforcement actions that result in monetary penalties are more likely to close within one year after the date of the final enforcement action than facilities that are not subject to such enforcement actions. The data also indicate that facilities that are subject only to informal enforcement actions are more likely to close within one year after the date of their final enforcement action than facilities that are subject to formal enforcement actions that do not result in monetary penalties.

## **5.0 CONCLUSIONS**

Cost estimates for closure and post-closure care of TSDFs are affected by many variables. This report attempted to identify trends in several such variables to determine which have the greatest effect on the accuracy of such cost estimates prepared by owners or operators of TSDFs. Given the limitations of the available data, the following general conclusions may be drawn:

- The percent difference between cost estimates tends to increase with the size of the facility. Because of economies of scale and a tendency to incorporate shared costs for common activities, costs may be underestimated more frequently and to a greater extent by owners and operators of large facilities than by owners and operators of small and medium facilities.
- Owners and operators of TSDFs that elect to use surety bonds, the financial test, or the corporate guarantee to demonstrate financial assurance for closure and post-closure care tend to prepare cost estimates that are more conservative, on average, than those prepared by owners or operators who use other types of mechanisms or who use no mechanism at all.

- Costs prepared by owners and operators for 1) contingencies, 2) transportation, treatment and disposal, 3) post-closure care, and 4) sampling and analysis tend to be lower than cost estimates for those activities prepared under the methodology. Costs for disposal at times, may be low because owners and operators tend to fail to account for the costs associated with managing decontamination fluids as a hazardous waste.
- The percent difference between the cost estimates prepared by owners or operators and the cost estimates prepared under the methodology tends to be greater in the case of waste piles and tank systems than in the case of other types of units.
- Owners and operators of facilities that were subject to enforcement actions that resulted in monetary penalties tend to prepare cost estimates that are less conservative, on average, than those prepared by owners and operators of facilities that were subject to different types of enforcement activities.
- Facilities that are subject to enforcement actions that result in monetary penalties appear to be more likely to close within one year after the date of their final enforcement action than facilities that are not subject to such enforcement actions. In addition, facilities that are subject only to informal enforcement actions are more likely to close within one year after the date of the final enforcement action than facilities that are subject to formal enforcement actions that do not result in monetary penalties.

An expanded set of data that provided cost estimates for a larger number of facilities would be useful for identifying additional trends and verifying the trends that have been identified through this analysis. The removal of “outliers” may also be useful in normalizing the data and refining the findings that are presented above.

**APPENDIX**  
**COST ESTIMATE DATA**

## DIFF

STATE	FACILITY NAME	EPA ID NO	FACILITY COST	METHODOLOGY COST	DIFFERENCE	% DIFFERENCE
AL	Akzo Chemicals, Inc.	ALD008464476	\$981,810	\$926,056	(\$55,754)	-6.02%
AL	Allied-Signal, Inc.-Fairfield Tar Plant	ALD031499833	\$102,794	\$273,735	\$170,941	62.45%
AL	Allworth, Inc.	ALD094476793	\$242,655	\$1,657,279	\$1,414,624	85.36%
AL	E.I. Dupont de Memours and Company - AL	ALD093179315	\$234,781	\$1,256,482	\$1,021,701	81.31%
AL	Fisher Industrial Services, Inc.	ALD981020894	\$303,729	\$842,861	\$539,132	63.96%
AL	Kimberly Clark Corporation	ALD004000790	\$2,234,160	\$1,380,972	(\$853,188)	-61.78%
AL	Koppers Industries, Inc.-Wood Preserving Plant	ALD000771949	\$2,102,100	\$3,082,320	\$980,220	31.80%
AL	Koppers Industries, Inc.-Woodward Coke Facility	ALD004009403	\$1,944,390	\$2,143,325	\$198,935	9.28%
AL	Koppers Industries, Inc.-Woodward Organics Plant	ALD085765808	\$575,400	\$2,806,229	\$2,230,829	79.50%
AL	Lafarge Corporation-Citadel Cement	ALD067119966	\$181,856	\$2,780,263	\$2,598,407	93.46%
AL	M&M Chemical Company	ALD070513767	\$524,153	\$2,498,432	\$1,974,279	79.02%
AL	Monsanto Chemical Company	ALD004019048	\$663,122	\$3,474,588	\$2,811,466	80.92%
AL	Stallworth Timber Company, Inc.	ALD058223371	\$1,970,794	\$7,369,896	\$5,399,102	73.26%
AL	Systech Environmental Corporation	ALD981019045	\$1,635,717	\$2,358,726	\$723,009	30.65%
AL	Terra First, Inc.	ALD983177015	\$2,546,947	\$3,926,573	\$1,379,626	35.14%
AL	U.S. Pipe and Foundry Company	ALD004017896	\$3,365,184	\$1,400,000	(\$1,965,184)	-140.37%
FL	American Cyanamid Company, Santa Rosa Plant	FLD0572318121	\$146,205	\$9,207,942	\$9,061,737	98.41%
FL	Ashland Chemical, Inc. - FL	FLD059851344	\$79,829	\$51,264	(\$28,565)	-55.72%
FL	Ashland Chemical, Inc. - FL (2)	FLD079859492	\$1,238,582	\$1,891,119	\$652,537	34.51%
FL	Chemical Conservation Corporation	FLD980559728	\$50,144	\$457,202	\$407,058	89.03%
FL	Envirotech Southeast, Inc.	FLD101877876	\$126,857	\$601,535	\$474,678	78.91%
FL	Flying Colors	FLD017625435	\$104,856	\$351,288	\$246,432	70.15%
FL	General Components, Inc.	FLD004988258	\$3,083,745	\$2,826,342	(\$257,403)	-9.11%
FL	International Business Machines Corporation	FLD079810008	\$158,534	\$364,332	\$205,798	56.49%
FL	Jacksonville Shipyards, Inc.	FLD137358974	\$1,047,713	\$3,639,554	\$2,591,841	71.21%
FL	Loral Data Systems	FLD083200998	\$450,802	\$491,172	\$40,370	8.22%
FL	Oldover Corporation - FL	FLD000737312	\$239,941	\$1,967,392	\$1,727,451	87.80%
FL	Pall Land and Marine Facility	FLD046855086	\$352,177	\$778,118	\$425,941	54.74%
FL	Southern Wood Piedmont Company	FLD004053450	\$1,161,701	\$2,520,918	\$1,359,217	53.92%
FL	Sparkle Corporation	FLD982121592	\$28,853	\$143,231	\$114,378	79.86%

## DIFF

STATE	FACILITY NAME	EPA ID NO	FACILITY COST	METHODOLOGY COST	DIFFERENCE	% DIFFERENCE
FL	Stone Container Corporation	FLD098208012	\$781,812	\$1,310,269	\$528,457	40.33%
GA	Alternative Energy Resources, Inc.	GAD033582461	\$122,570	\$694,928	\$572,358	82.36%
GA	Ashland Chemical Company - GA	GAD066465824	\$11,697	\$11,762	\$65	0.55%
GA	Ensco Env. Services of Georgia, Inc.	GAD000222083	\$204,244	\$872,275	\$668,031	76.58%
GA	LCP Chemicals-Georgia	GAD099303182	\$703,247	\$2,637,015	\$1,933,768	73.33%
GA	Merck and Company, Inc.	GAD003324985	\$1,391,310	\$1,222,712	(\$168,598)	-13.79%
GA	Southwire Company	GAD000814541	\$382,074	\$2,903,339	\$2,521,265	86.84%
GA	Tri-State Steel Drum, Inc.	NA	\$678,379	\$1,881,690	\$1,203,311	63.95%
GA	W.C. Meredith Company, Inc.	GAD003323805	\$542,496	\$576,665	\$34,169	5.93%
KY	Ashland Petroleum Company	KYD000615898	\$20,852,000	\$54,239,626	\$33,387,626	61.56%
KY	Corning Glass Works	KYD006388797	\$19,462	\$102,889	\$83,427	81.08%
KY	Elf Atochem North America, Inc.	KYD006373922	\$738,929	\$1,466,597	\$727,668	49.62%
KY	Ensign-Bickford Company	KYD061557054	\$20,319	\$1,055,355	\$1,035,036	98.07%
KY	Koppers Industries, Inc. - KY	KYD006383392	\$2,985,774	\$2,209,945	(\$775,829)	-35.11%
KY	LWD, Inc.	KYD088438817	\$695,744	\$884,591	\$188,847	21.35%
KY	LWD, Inc. (2)	KYD985073196	\$521,265	\$6,923,947	\$6,402,682	92.47%
KY	Newport Steel Corporation	KYD991277112	\$5,175,645	\$10,172,898	\$4,997,253	49.12%
KY	Olin Corporation - KY	KYD006396246	\$456,142	\$602,944	\$146,802	24.35%
MS	Arizona Chemical Company	MSD001661719	\$391,520	\$1,025,373	\$633,853	61.82%
MS	Ashland Chemical Company - MS	MSD000829150	\$14,420	\$64,606	\$50,186	77.68%
MS	First Chemical Corporation	MSD033417031	\$2,478,193	\$3,914,427	\$1,436,234	36.69%
MS	Houston Ceramics, Inc.	MSD054543129	\$14,573	\$2,179,014	\$2,164,441	99.33%
MS	Koppers Industries, Inc. - MS	MSD007027543	\$2,008,679	\$2,127,711	\$119,032	5.59%
MS	Morton Thiokol, Inc., Morton Chemical Division	MSD008186587	\$4,723,881	\$39,787,911	\$35,064,030	88.13%
MS	Rodgers Rental and Landfill Company	MSD083543009	\$2,916,536	\$3,286,605	\$370,069	11.26%
NC	Allied-Signal, Inc.	NCD003122542	\$40,580	\$47,323	\$6,743	14.25%
NC	American Cyanamid Company	NCD003168168	\$1,384,194	\$2,417,172	\$1,032,978	42.73%
NC	Burroughs Wellcome Company	NCD047373766	\$1,081,172	\$1,967,034	\$885,862	45.04%
NC	Carolina Solite Corporation	NCD003152642	\$60,388	\$134,466	\$74,078	55.09%
NC	Detrex Corporation	NCD043779245	\$427,000	\$462,175	\$35,175	7.61%
NC	Glaxo, Inc.	NCD065655599	\$237,602	\$492,754	\$255,152	51.78%
NC	Mallinckrodt Chemical, Inc.	NCD042091975	\$538,835	\$477,805	(\$61,030)	-12.77%
NC	Oldover Corporation - NC	NCD000773655	\$103,801	\$1,571,808	\$1,468,007	93.40%
NC	Pure-Etch Company	NCD095119210	\$105,805	\$204,485	\$98,680	48.26%
NC	Sandoz Chemicals Corporation	NCD001810365	\$55,738	\$2,300,402	\$2,244,664	97.58%



## DIFF

STATE	FACILITY NAME	EPA ID NO	FACILITY COST	METHODOLOGY COST	COST DIFFERENCE	% DIFFERENCE
SC	Albright & Wilson Americas	SCD003358389	\$411,273	\$361,539	(\$49,734)	-13.76%
SC	Carolina Plating Works - Industrial Division	SCD003351996	\$463,446	\$1,530,709	\$1,067,263	69.72%
SC	Eliskim, Inc.	SCD303342938	\$2,562,379	\$3,486,200	\$923,821	26.50%
SC	General Electric Company	SCD067002147	\$1,258,000	\$2,315,161	\$1,057,161	45.66%
SC	Giant Cement Company	SCD003351699	\$4,514,555	\$16,148,058	\$11,633,503	72.04%
SC	Hudson International Conductors	SCD061523098	\$903,196	\$939,406	\$36,210	3.85%
SC	Laidlaw Environmental Services (TOC), Inc.	SCD981467616	\$2,348,790	\$4,923,406	\$2,574,616	52.29%
SC	Phibro-Tech, Inc.	SCD070371885	\$537,183	\$4,021,182	\$3,483,999	86.64%
SC	Platt Saco Lowell Corporation	SCD065053217	\$594,274	\$5,424,653	\$4,830,379	89.04%
SC	Safety-Kleen Corp.-Lexington Recycling Center	SCD077995488	\$1,199,372	\$7,090,936	\$5,891,564	83.09%
SC	Southern Chemical and Solvent, Inc	SCD036275626	\$330,165	\$3,264,178	\$2,934,013	89.89%
SC	Steel Heddle Mfg. Company	SCD002267490	\$484,785	\$1,185,678	\$700,893	59.11%
SC	Stoller Chemical Company, Inc.	SCD046503132	\$169,443	\$3,767,278	\$3,597,835	95.50%
SC	ThermalKEM, Inc.	SCD044442333	\$1,030,188	\$6,235,104	\$5,204,916	83.48%
SC	Thomas and Betts Lancaster Operations	SCD048462378	\$1,033,412	\$464,366	(\$569,046)	-122.54%
TN	Allworth of Tenn., Inc.	TND984920119	\$2,470,095	\$8,804,910	\$6,334,815	71.95%
TN	American Resource Recovery	TND991279480	\$416,718	\$4,455,341	\$4,038,623	90.65%
TN	Ashland Chemical, Inc. - TN	TND095058541	\$45,514	\$77,656	\$32,142	41.39%
TN	Bryson Recovery Services, Inc.	TND980847024	\$186,493	\$356,296	\$169,803	47.66%
TN	Davis Pipe and Metal Fabricators, Inc.	TND066723263	\$374,160	\$1,558,456	\$1,184,296	75.99%
TN	E.I. Dupont de Memours and Company - TN	TND007024672	\$248,756	\$269,468	\$20,712	7.69%
TN	IT Corporation-Env. Technology Development Center	TND054692967	\$126,179	\$317,344	\$191,165	60.24%
TN	Laidlaw Env. Services (GS), Inc.	TND000645770	\$307,267	\$506,614	\$199,347	39.35%
TN	Laidlaw Environmental Services (TS), Inc.	TND000614321	\$683,835	\$1,027,534	\$343,699	33.45%
TN	Olin Corporation - TN	TND003337292	\$1,281,679	\$2,455,831	\$1,174,152	47.81%
TN	OSCO Treatment Systems, Inc.	TND981922826	\$275,825	\$2,088,681	\$1,812,856	86.79%
TN	Rohm and Haas Tennessee, Inc.	TND058660390	\$656,262	\$489,174	(\$167,088)	-34.16%
TN	Scientific Ecology Group Bear Creek Facility	NA	\$1,797,038	\$2,594,783	\$797,745	30.74%
TN	St. Elmo Avenue Landfill-Wheland Foundry	TND987778495	\$753,840	\$1,068,456	\$314,616	29.45%

## DIFF

STATE	FACILITY NAME	EPA ID NO	FACILITY COST	METHODOLOGY COST	DIFFERENCE	% DIFFERENCE
TN	Tennessee Eastman Division	TND003376928	\$32,949,040	\$293,356,710	\$260,407,670	88.77%
TN	Thomas Industries, Inc.	TND006379200	\$341,843	\$529,711	\$187,868	35.47%
TN	Tricil Nashville Regional Pretreatment Center	TND000772277	\$341,827	\$1,375,039	\$1,033,212	75.14%
TN	Universal Fasteners, Inc.	TND069080513	\$345,494	\$856,889	\$511,395	59.68%
TN	Van Waters and Rodgers, Inc.	TND000737445	\$45,283	\$70,123	\$24,840	35.42%
TN	Yale Security, Inc.	TND095050019	\$327,628	\$367,626	\$39,998	10.88%